

Land Use/Cover Mapping of Konkan Region, Maharashtra

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ABSTRACT

The land is used for different activity, such as agriculture, forests, mining, transport, settlement, entertaining and manufacturing. The unused lands are unproductive waste and i.e. barren and fallow (temporary and permanent) land. Green canopy plays an important role in maintain surface temperature and humidity. The present study land use and land cover was identified through exploratory analysis, done on the bases of multitemporal Landsat TM data. The final classification map provided the land use and land cover information. The ground truthing was used to assess the accuracy of the land use and land cover analysis. Three specific bands were used with reasonable success to correlate soil, wetness and vegetation. The present study the cropland covers the highest area 10814 square kilometer in percent 35.17. Dense forest cover second large area 5653 square kilometer in percent 18.39. The settlement covers the lowest area, which is 678 square kilometer in percent 2.18. Combinations of supervised and unsupervised classifications were conducted to define land cover and land use types for the study area. The resulting products of the exploratory analyses and classification were then used to assess spatial patterns of land cover and land use in the study area.

Key Words: Land use, Land cover, Remote sensing, Image classification, Konkan Region

INTRODUCTION

The land is necessary for human survival because it's available for a human with living space (Bhagawat, 2011). The idea of depicting the use of land in a map was first conceived by Saucer in 1919. Stamp in Britain is given a contribution regarding land use mapping study. The concept of land use has been defined by Stamp in 1962. The land should fulfill all the necessary and legitimate needs of the nation (Stamp, 1930). According to Nanavati conservation of land is also connected with land use (Nanavati, 1951). This needs strong scientific, rational and economic preparation to use the available resource of land, on another side we have to maintain ecological and socio-economic balance (Mohammad, 1980). The land use and land cover are indispensable for human development (Doke, 2017).

The development in the remote sensing and Geographical Information System environment present day support to the change detection as well as monitoring of earth surface resources (Aher and Dalvi, 2012). The land use is the result of a combination of both natural genesis and human influences which have been brought to bear on it in the past and of those

which are still active in the present (Vink, 1975). Satellite remote sensing imagery and it's coupled in GIS environment for land use/land cover analysis is a key to many diverse applications such as environment, forestry, hydrology and agriculture (Parlhad and Deore, 2010). Any areas natural resource management watershed management (Deshmukh et al., 2012) planning and monitoring depend on accurate information about the land cover in a region. The accurate representation of terrestrial vegetation is a key requirement for global change research (Jung et al. 2006; Lambin et al. 2001). The vegetation map is an essential base map for managing natural resources as vegetation provides a base for all living beings and plays an essential role in affecting global climate change, such as influencing terrestrial CO₂ (Xiao et al. 2004). In order to initiate vegetation protection and restoration programs, it is necessary to obtain the current status of vegetation cover (Egbert et al. 2002; He et al. 2005). The traditional methods such as field surveys, literature reviews, map interpretation and collateral and ancillary data analysis, are not effective to acquire land use and land cover because they are time consuming, date lagged and often too expensive. In recent decade remote sensing techniques are being

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widely used for land use and land cover mapping and change detection (Boyd et al., 2003; Ingram, 2005; Lu et al., 2004; Maynard et al., 2007; Dadhwal et al., 2009) which measures the spectral reflectance of the land cover (Zianis et al., 2005).

The remotely sensed spectral signatures are used for understanding the nature of vegetation characteristics however, it is affected by various factors like vegetation composition, soil characteristics, atmospheric conditions, topography and moisture content (Chen and Wang, 2008). Remote sensing has been the only feasible way of acquiring vegetation information over vast areas at a reasonable cost and acceptable accuracy due to repetitive data collection at a feasible effort (Lu, 2006). The developments in sensor technology have allowed the acquisition of remotely sensed data at a various range of scales ranging from coarse spatial resolution of 500 m (e.g., NOAA AVHRR, MODIS) to medium spatial resolution of 20_30 m (e.g., Landsat TM, Landsat ETM+, SPOT HRVIR) as well as high spatial resolution of less than 5 m (e.g., Ikonos, Quick Bird, LIDAR, and others). The coarse spatial resolution optical sensors such as NOAA AVHRR (Dong et al., 2003) and MODIS (Baccini et al., 2004) have been useful for mapping vegetation at the global, continental, national and regional scale, because of spatial resolution, image coverage and high frequency in data acquisition (Lu, 2006).

The medium resolution satellite imagery such as Landsat TM is used at regional and at a local scale for vegetation mapping. The Landsat Thematic Mapper (TM) use in Land use and Land cover mapping (Hall et al., 2006; Heiskanen, 2006; Ingram, 2005; Lu, 2006; Lu et al., 2004). The thematic mapper (TM) is an advanced, multispectral scanning, earth resources sensor designed to achieve higher image resolution, sharper spectral interval, improved geometric fidelity, and greater radiometric accuracy and resolution than that of the MSS sensor.

Study Area

Konkan Region is one of six administrative divisions of Maharashtra State in India. Konkan is the west division in the state, with an administrative headquarters in the city of Mumbai and it is also state capital as well as financial capital of India. Amravati and Nagpur divisions makeup the region of Vidarbha. The seven districts i.e. Mumbai City, Mumbai Suburban, Raigad(Alibag), Ratnagiri, Sindhudurg, Thane and Palghar (1stAugust 2014) is included in the Konkan Region shown in Figure 1. Total area is 36,740 square km, total population 28,739,397 and literacy 98.88 percent.

The ‘Konkan’ is the narrow strip of the coastal land situated between Arabian Sea and Western Ghats escarpment. The famous Western Ghats is lying in the ‘Konkan’. ‘Damanganga’ River separating Maharashtra and Gujarat States forms the northern limit of ‘Konkan’. In the south it extends

up to ‘Terekhol’ Creek. The ‘Konkan’ strip is extended for about 720 km in north-south direction and is a distinct physiographic region of the State. The ‘Konkan’ region forms dissected topography and its average East-West extension is 40-50 km which varies considerably within the coastal lowland and decreased from north to south (Karlekar, 2002). Width of the region decreases as one proceeds toward south. The widest stretch is about 110 km in Ulhas river basin in north Thane District (Jog et al., 2002). Elevation of most of the ‘Konkan’ lies below 200 m ASL. The area of ‘Konkan’ varies in lithology, geomorphic configuration, nature of hinterland and climate. ‘Konkan’ region of Maharashtra can be conveniently divided into North ‘Konkan’, Middle ‘Konkan’ and South ‘Konkan’. These division is based on Physico-climatic characteristics of the region suggested by Dikshit (1986).

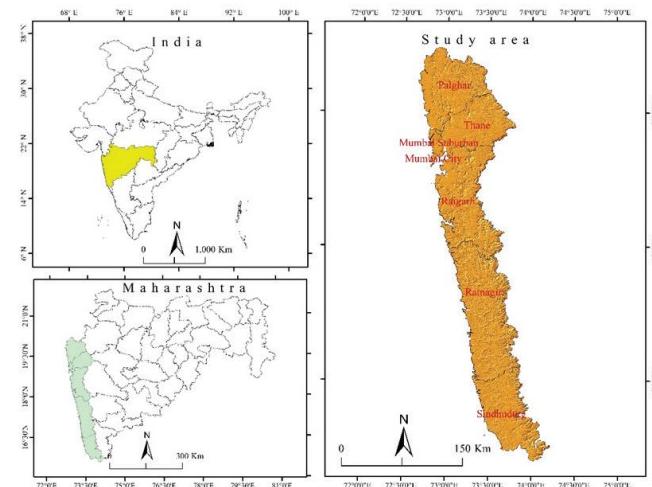


Figure 1: Location map of Study area.

Objective

To classification of Land Use and Land Cover using Remote Sensing Data in Konkan Region.

MATERIALS AND METHODS

Landsat TM FCC (bands 4, 3 and 2, scale 1: 50,000, December, 2016) were used for this study. Using Erdas Imagine software 14, downloaded Landsat images were mosaiced together and Project to UTMWGS 84 coordinate system. The study area was extracted by subsetting from the whole image. The flowchart of the research methodology can be divided into five stages: (i) preparation of reference maps for gathering the existing and relevant information in the spatial form, (ii) pre-field classification of the satellite data, (iii) ground truthing, (iv) post-field correction and (v) field verification of the final map. The spectral variation of each vegetation type was extracted from digital data by interpreting satellite images based on the interpretation elements such as

the image color, texture, tone, pattern and association information etc. The standard “falsecolor” composite. Vegetation looks in shades of red. Coniferous trees will seem darker red than hardwoods. For land cover and land use study, this is a very standard band combination. Typically dark red color indicates healthy vegetation covers including wide leaf and light red color indicates sparsely vegetated land cover which includes grass land areas. Diverse methods have been developed to do this. Those methods can be broadly grouped into unsupervised classification or supervised classification depending on whether or not true ground data are inputted as references (table 1). The flow chart of the research methodology is shown in Figure 2.

Table 1: LULC classification classes and description.

Class	Description
Settlement	Includes all residential, commercial, and industrial development.
Agricultural Land	Includes all vegetation features that are not typical of forest, including agricultural and pasture grasslands, recreational grasses.
Vegetation Class	All forest vegetation types including dense forest, open forest, and scrub or shrub like vegetation features.
Wetlands	Predominately wetland or marsh features associated with the coastal zone, rarely indicative of upland wetland features or forested wetland vegetation.
Fallow Land	Barren or sparsely vegetated areas most often representative of bare earth or soil.
Water Bodies	All water bodies including freshwater lakes, rivers, and streams, as well as marine water environments.

Source: Author Description

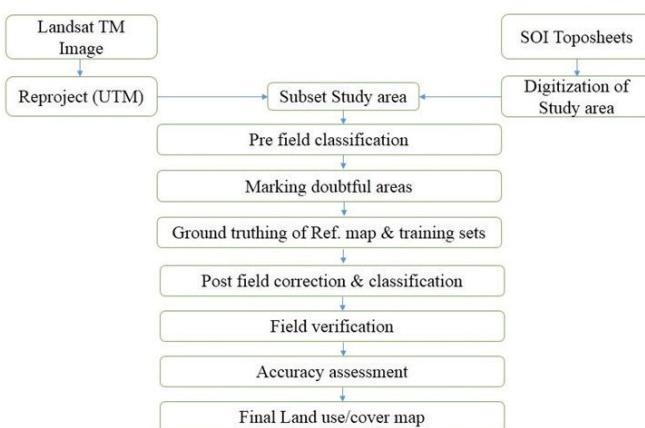


Figure 2: Flow Chart of Research Methodology.

RESULT AND DISCUSSION

The entire area of the study is almost flat only north western part is hilly. Figure 3 represent the physical division of the

study area. The vegetation map inferred from image classification is considered accurate if it provides a true representation of the region it portrays (Foody 2002; Weber 2006). The rectified Landsat TM scenes covering districts were analyzed to generate the vegetation map. All the major forest classes (viz. dense forest, open forest, scrubs) were classified. Along with forest, other land use/cover classes (viz. cropland, fallow land, wetland, settlement and water bodies) found in the Konkan Region. Table 1 gives the statistics of the study area generated from the classified output of the Landsat TM data. Table 2 shows the spatial extent of land cover in square kilometer and in percentages.

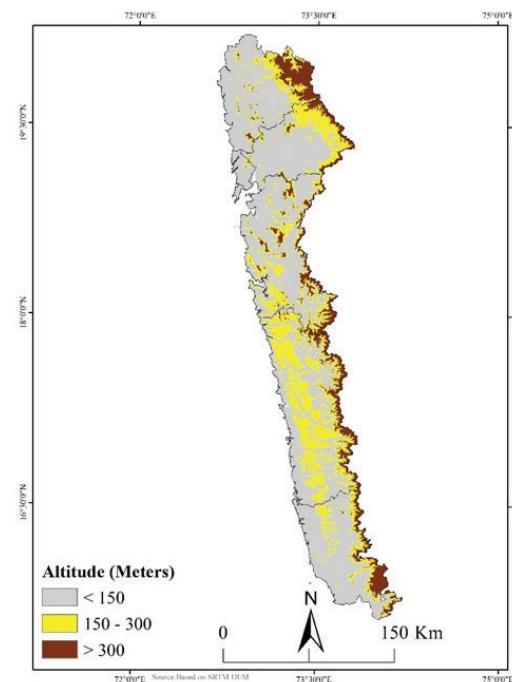


Figure 3: Physical Division of Study area.

Table 2: Statistics of the Study area

Sr. No.	Land Use/Cover Classes	Area (Km ²)	Per cent of total area
Vegetation Class			
1	a Dense Forest	5653	18.39
	b Open Forest	2732	8.89
	c Scrubs	5055	16.44
Agricultural Land			
2	a Crop Land	10814	35.17
	b Fallow Land	4189	13.62
Wetland			
3	a Wetland	879	2.86
Settlement			
4	a Settlement	678	2.21
Water Bodies			
5	a Water Bodies	746	2.43

The total forest area is 43.72 (13440 square km) percent of the total geographical area of the Konkan Region. The moist dense forest constitutes the bulk of the total forest area and was found in around the west side of Western Ghat (fig.4). Open forest covers 2732 square km (8.89 Percent) and Scrubs cover 5055 square km (16.44 Percent). Agriculture covers the larger area of Konkan region 10814 square km (35.17 Percent).

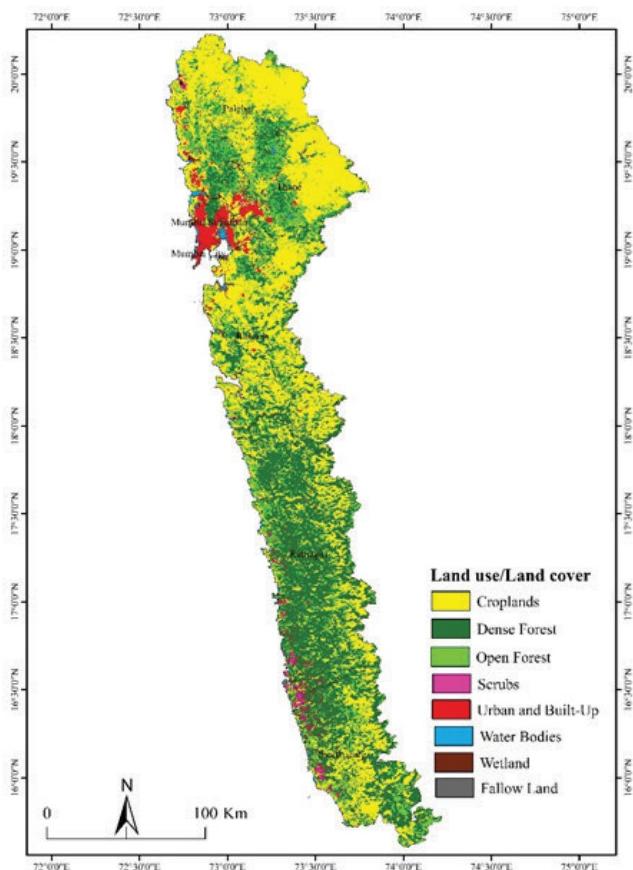


Figure 4: Land use/cover classification of Study area

Wetland cover the small area around 879 square km (2.86 Percent). The water bodies cover 2.43 percent (746 square km) area. Open land and scrub land covers an area of 16.44 per cent. The table 2, gives the land use/cover statistics of Konkan Region generated from the classified output of the Landsat TM data. The main tree species of this forest are Ain (*Terminalia tomentosa*), Jambha (*Xylia dolabriformis*), Kinjal (*Terminalia paniculata*), Sagwan (*Tectona grandis*), Surangi (*Mammea meusuriga*), Kokam (*Garcinia indica*), Kumbha (*Careya arborea*), Karmal (*Dillenia pentagyna*), Amba (*Mangifera Indica*), Bibba (*Semecarpus anacardium*), Asana (*Bridelia retusa*), Anjani (*Memecylon umbellatum*), Shisham (*Dalbergia latifolia*), and Khair (*Acacia catechu*). At several locations, the forests were found in the varying stages of degradation. The output classified map is shown in Figure 4. The accuracy assessment in the

first stage is done by visual inspection of derived maps; however, the method is highly subjective and often not accurate. The second stage is more objective methods in which comparisons of the area extents of the classes in the derived thematic maps (e.g. the percentage of a specific vegetation group in the area) are made with the corresponding extents on ground or in other reference datasets. Accuracy assessment for the forest mapping was done with randomly selected sample distribution points on the ground and tallied with represented data. The classification was validated with 180 randomly selected sample points. The total accuracy of the forest cover mapping, therefore, comes to be 82.12%. The discrepancy in the forest area may be due to time on which the satellite data for the present study was acquired.

CONCLUSION

The present study demonstrated the effective role of the spatial technologies in land use and cover types. The results of land use and cover mapping from remote sensing imagery represent well with the actual land cover community composition. The optimal use of satellite imagery in land use and cover mapping is effective when it is complemented with fieldwork. When selecting a right vegetation classification system for better classification accuracy, the following points should be taken into consideration (i) refining class definitions to decrease ambiguity, (ii) adding sufficient number of new classes to describe the complexity of local vegetation patterns and (iii) using a higher level of classification (Rapp et al. 2005). To map vegetation under such circumstances various difficulties are often encountered hence it is better to adopt more advanced image classification method such as sub-pixel analysis (Lee and Lathrop 2005). Another solution is to choose higher resolutions of imagery so as to increase the distinguishable possibility in image classification (Cingolani et al. 2004), however higher resolutions of imagery will most likely increase the cost. Though there are some standard methods for image preprocessing, however, there are no super image classifiers that can be uniformly applicable to all applications, hence it is hot research topic, to apply effective classifiers or to develop new powerful classifiers suitable for specific applications. The present study can be used as baseline information for policy and decision makers to develop sound management strategies for effective natural resource management as well as regional planning for the study area (Konkan Region).

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